

Arthroscopic acetabuloplasty without labral detachment for focal pincer-type impingement: a minimum 2-year follow-up

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ABSTRACT

In order to access and resect the acetabular rim, arthroscopic acetabuloplasty was described with labral detachment. When the chondrolabral junction remains intact, acetabuloplasty and labral refixation can be performed maintaining an unharmed labrum. We aimed to evaluate the outcome of a group of patients treated with arthroscopic acetabuloplasty without labral detachment. During the study period, we retrospectively analysed 44 patients with pincer-type or combined impingement and an intact chondrolabral junction, with an average follow-up of 32 months (range: 27–38). We excluded patients with isolated CAM-type impingement and previous hip pathology. Radiographs were analysed to define impingement and classify grade of osteoarthritis. Clinical evaluation consisted of pre-operative and post-operative modified Harris hip score (mHHS) and WOMAC as well as post-operative visual analogue scale (VAS) of pain and satisfaction. Reoperations were considered surgical failures for purposes of survival analysis. Mean mHHS changed from 51.06 (SD 4.81) pre-operatively to 84.97 (SD 12.79) post-operatively. Pre-operative WOMAC was 29.18 (SD 8) and post-operative, 13.10 (SD 11). Post-operative VAS was 7.5 and 2.27 for satisfaction and pain, respectively. When comparing patients with Tönnis 0 to those with Tönnis 1, the former showed better results regarding post-operative mHHS (89.9 versus 77.85, $P=0.03$), pain VAS (1.5 versus 6.3, $P=0.03$) and satisfaction VAS (8.2 versus 6.3, $P=0.01$). Survival was 100% at 24 months and 76% at 40 months (95% CI: 35–98%). Arthroscopic acetabuloplasty without labral detachment achieved good clinical outcomes. Slight degenerative changes on radiographs correlated with poorer clinical outcomes.

INTRODUCTION

Hip labral pathology has been acknowledged as a common cause of persistent hip pain and dysfunction [1]. Usually, labral tears are non-traumatic and conceived in the context of femoroacetabular impingement (FAI) or hip instability. FAI is known to be one of the main causes of osteoarthritis, rather than abnormal contact between the femoral head and the anterosuperior rim of the acetabulum [2, 3]. Two patterns of FAI have been described; CAM-type FAI as a result of loss of the femoral head sphericity or the head-neck junction offset and pincer-type impingement when there is focal or global acetabular overcoverage [4, 5]. Likewise, both patterns can coexist originating a combined impingement.

Sole pincer-type impingement occurs frequently in women population [6]. Global overcoverage arises in cases of coxa profunda or protrusio acetabuli, producing extensive labral damage; whereas focal rim overcoverage appears when a linear overhang exists at the antero-superior edge of the acetabulum [5, 7], with a normal relationship between the anterior and posterior walls distally. Additionally, in cases of genuine retroversion, impingement at the cephalad portion of the acetabular rim befalls at a lower range of motion. Arthroscopic treatment of focal pincer consists of resecting the surplus rim at the antero-superior acetabular area, previously described as zones 2 and 3 by Ilizaliturri *et al.* [8].

In order to access the mentioned geographic zone and adequately expose the bony excrescence, the traditional technique involves labral debridement or labral detachment and refixation [7, 9]. In cases of marked retroversion or when there is extensive bony excess that does not significantly overhang, a formal labral takedown with an arthroscopic beaver blade is recommended in order to perform the resection [6]. During this procedure, there is an implicit risk of damaging the chondrolabral junction or the acetabular cartilage, hence altering the contact pressures between the ball and socket [10].

In the literature at our disposal, only three studies have described the outcome of patients with pincer-type impingement treated with rim resection without labral detachment [11–13], even though we are well aware that the technique has been priorly portrayed [6, 7, 9]. Therefore, we aimed to evaluate the outcome of a group of patients with pincer-type FAI treated with arthroscopic acetabuloplasty without labral detachment.

MATERIALS AND METHODS

We retrospectively analysed a consecutive series of patients with diagnosis of a labral rupture secondary to pincer-type or combined impingement treated with a hip arthroscopy between January 2012 and June 2015. Only patients with an intact chondrolabral junction treated with acetabuloplasty without labral detachment and a minimum 2-year follow-up were included. We excluded patients with isolated CAM-type impingement; os acetabuli; coxa profunda or protrusio acetabuli; degenerative labrum with extensive damage not suitable for fixation; revisions and previous ipsilateral hip pathology such as avascular necrosis, Legg–Calves–Perthes disease, slipped capital femoral epiphysis or dysplasia.

Demographic characteristics as well as radiological and clinical outcomes were obtained from the medical records of our prospectively collected electronic database. These data were reviewed by three investigators, two of them not involved in patients' original care.

Radiological evaluation was done by the primary surgeon and a senior resident, through a profound analysis of an anteroposterior radiograph of the pelvis, a Dunn's lateral axial view (hip in 45° of flexion, 45° of abduction and foot in neutral rotation) and a false profile view. In order to estimate acetabular version, we considered as an acceptable anteroposterior X-ray when the coccyx was centered at the pubic symphysis, with a distance between them of approximately 0–3 cm, including a symmetric obturator foramina [14]. We performed the following radiographic measurements: lateral center-edge angle of Wiberg; anterior center-edge angle; alpha angle; ischial spine sign;

posterior wall sign and cross-over sign [14, 15]. The grade of pre-operative osteoarthritic degeneration was categorized with the Tönnis classification [16]. The diagnosis of pincer-type FAI involved the presence of at least two of the following: positive cross-over sign; positive posterior wall sign; lateral center-edge angle greater than 35° and positive ischial spine sign [17]. Although the presence of os acetabuli is compatible with the diagnosis of pincer and acetabular retroversion [18], we excluded patients with this sign as it is related to labral intrasubstance tears, usually treated with debridement and labral detachment.

Without a standardized protocol, additional imaging involved assessment with computed axial tomography and nuclear magnetic resonance [19] to study the femoroacetabular anatomy, the type of labral tear, the presence of osteochondral injuries as well as to discard associated pathologies. Our general indications for arthroscopic treatment consisted of absence of conservative treatment response for at least a 3-month period, including 6 weeks of physical therapy [20]. Additionally, if patients were increasingly symptomatic with restraints in performing activities of daily living in a shorter period than the one mentioned, we suggested surgical treatment.

The surgical procedure consisted of the traditional technique with the patient in supine position on a traction radiolucent table, with well-padded protections over the genitals and the feet. The contralateral lower extremity was positioned in abduction. We used the conventional anterolateral and midanterior arthroscopic portals, placed through radioscopic assessment. A 70° arthroscope was always utilized. Osteochondral injuries were assessed intraoperatively with the Outerbridge classification, measuring the damage extent with a 5 mm hook. In case of diagnosing a chondral injury, a microfracture was performed to stimulate the development of a fibro-cartilaginous tissue. Intraoperatively, we certified the presence of pincer-type or combined FAI along with an unharmed chondrolabral junction (Fig. 1). Chondrolabral junction was defined as the transitional area between the labrum and the acetabular cartilage located less than 3–6 mm away from the former [21]. The labrum was identified and not detached, using a 5.5 mm high-speed burr to remove the anterosuperior bony overhang under radioscopic assessment (Fig. 2). After acetabuloplasty, the labrum was inspected for instability with a 4.8 mm Hook Tip (Arthrex®); if it was unstable, advancement and refixation with 3.2 mm anchors (Arthrex®) was performed. The number of anchors utilized was confirmed using our institutional billing records and depended on each case in particular.

The rehabilitation protocol consisted of partial weight bearing with crutches during the first two post-operative

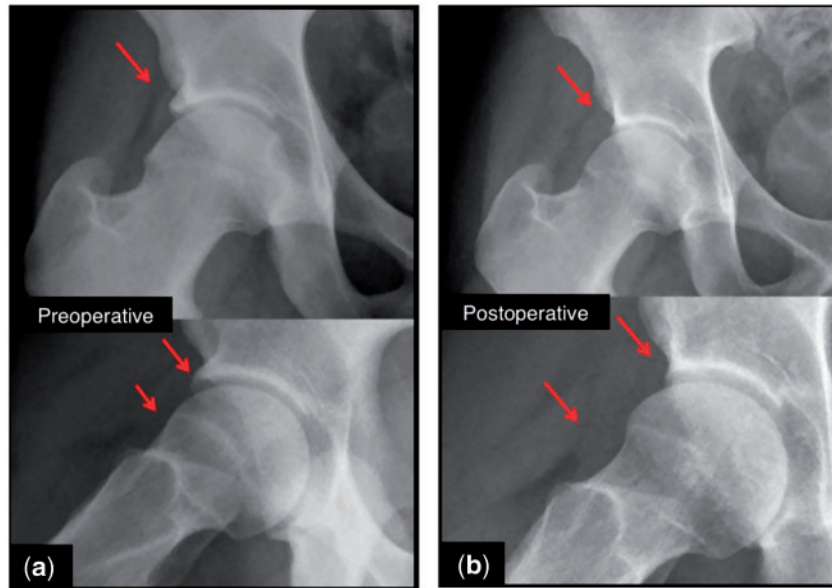


Fig. 1. (a) Anteroposterior and false profile radioscopic images of the right hip of a 29-year-old patient evidencing a combined FAI (red arrows). (b) Anteroposterior and false profile radioscopic images of the right hip of the same patient after femoral and acetabular arthroscopic osteoplasty (red arrows).

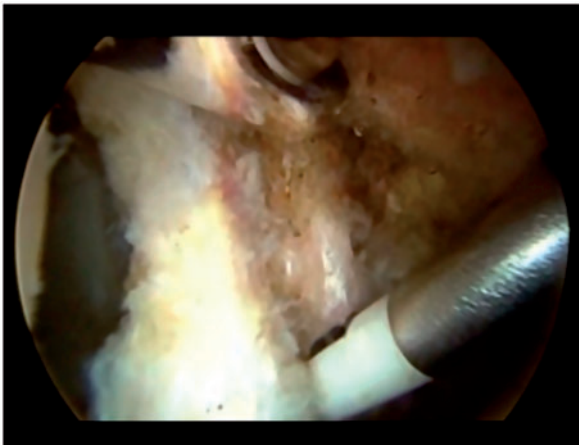


Fig. 2. Intraoperative image of the right hip of the patient mentioned in Fig. 1 after the arthroscopic acetabuloplasty without taking down the labrum, through the anterolateral portal. A radiofrequency hook is used for tidying the appearance of the rim reduction.

weeks, with fixed range of motion exercises at 90° of flexion, neutral internal rotation, 30° of external rotation and 30° of abduction for 3–6 weeks. Patients with microfractures had protected weight bearing for 6 weeks. Return to sports was indicated in a 4–6-month period, depending on the gained muscular strength.

The clinical outcome was measured with the modified Harris hip score (mHHS) pre- and post-operatively; the

WOMAC score pre- and post-operatively; as well as with the visual analogue scale (VAS) for post-operative pain and satisfaction. We considered revision surgeries (new arthroscopy, surgical dislocation or conversion to total hip replacement [THR]) as articular failures for purposes of survival analysis. We defined revisions as reoperations performed to correct undesired sequelae of the previous surgery [22].

Continuous variables were expressed as mean and range or standard deviation. Mann–Whitney *U* test was used for continuous variables. Fisher's exact test was used for categorical variables. Given that currently hip arthroscopy tends to be contraindicated in patients with established severe osteoarthritis [23, 24], we separated two groups of patients with minimal osteoarthritic changes (Tönnis 0 group and Tönnis 1 group) to compare their clinical outcome. Likewise, another subgroup of patients in terms of age was studied (age >35 years old or age ≤35). *P*-values <0.05 were considered statistically significant. A survival analysis was done considering articular failures and last follow-up with the Kaplan–Meier estimate. Statistical analysis was conducted using R software (version 2.7.0).

RESULTS

A total of 44 patients treated with arthroscopic acetabuloplasty fulfilled the selection criteria. Thirty-six were men (81%). Forty patients (90%) had an initial diagnosis of combined impingement whereas four (10%) had pincer-type FAI. Mean follow-up was 32.2 months (range: 27–40).

Table I. Average values of the pre-operative radiological measurements

Radiological measurement	Value
Lateral center-edge angle of Wiberg (°)	35
Anterior center-edge angle (°)	29
Alpha angle (°)	54
Presence of cross-over sign (%)	82
Presence of ischial spine sign (%)	100
Presence of posterior wall sign (%)	64
Pre-operative Tönnis (%)	—
0	55
1	34
2	11

Baseline characteristics of the patients. Data are shown as average or as percentage for each measurement.

Mean lateral center-edge angle of Wiberg was 35° (SD ± 7.65) whereas mean anterior center-edge angle was 29.5° (SD ± 3.34). Mean alpha angle of the series was 54° (SD ± 5.21). The ischial spine sign was present in 44 cases (100%) while the cross-over sign in 36 (82%). The posterior wall sign was positive in 28 cases (64%), as specified on Table I.

Considering the pre-operative degenerative changes, 24 patients (55%) were Tönnis 0, 15 (34%) Tönnis 1 and 5 (11%) Tönnis 2 (Table I). Intraoperatively, seven patients were free of osteochondral injuries. Ten patients had Outerbridge 1 injuries, 16 Outerbridge 2, 3 Outerbridge 3 and 8 Outerbridge 4. A mean of 2.09 anchors were used (min 1; max 3) to fix the labrum; in all cases a labral refixation was performed after the rim resection.

Mean overall pre-operative mHHS was 51.06 (DS ± 4.81) while the post-operative one was 84.97 (SD ± 12.78) ($P=0.002$). Mean overall Womac scale improved from 29.18 (SD ± 8) pre-operatively to 13.10 (SD ± 11), post-operatively ($P=0.003$). Mean overall post-operative VAS for pain and satisfaction were 2.27 and 7.5, respectively. When comparing patients with Tönnis 0 to those with Tönnis 1, the former showed significantly better results regarding post-operative mHHS (89.9 versus 77.85, $P=0.03$), pain VAS (1.5 versus 6.3, $P=0.03$) and satisfaction VAS (8.2 versus 6.3, $P=0.01$). Although not statistically significant, there was a trend towards a superior post-operative WOMAC for Tönnis 0 patients (8.31 versus 19.3, $P=0.05$) when compared with the

Tönnis 1 group. There were no pre-operative differences in mHHS and Womac scales between both groups (Table II). When analysing our outcome results in terms of age, no significant differences in post-operative scores were found between patients older or younger than 35 years old, as expressed on Table III. The only measurement that evidenced a statistical difference was pre-operative mHHS, being worse in the group of patients older than 35 (48.33 versus 52.48, $P=0.02$).

Three of the forty-four patients were reoperated, exhibiting a 76% survival at 40 months (95% CI: 35–98%), as shown on Fig. 3. Two of those patients were treated with a new arthroscopy. One of them developed a traumatic injury of the labrum during a soccer match at 4 months post-operatively, once the patient had returned to sports; whereas the other was diagnosed with a chondrolabral injury with subchondral osseous edema at 4 months post-operatively. The remaining revision consisted of a surgical dislocation performed in a rugby player at 9 post-operative months due to the development of advanced osteoarthritis with marginal osteophytes and medial joint space narrowing. Although this patient refused conversion to THR, no conversions to arthroplasty were found at final follow-up.

DISCUSSION

Arthroscopic treatment of pincer-type FAI frequently involves rim resection and concomitant labral repair or debridement, depending on the labral tear pattern. Isolated acetabular over-coverage usually results in crushing the labrum between the acetabular rim and femoral neck due to continued edge loading [4, 25–27]. In this scenario, the chondrolabral junction may not be harmed; differently to CAM-type impingement, in which disruption of the labrochondral intersection does naturally exist [6, 25–27]. However, the vast majority of the hips in this series exhibited a combined impingement with intra-articular findings suitable for both cam and pincer labral pathology. Our selection criteria involved only patients with an unharmed chondrolabral junction, despite most of the patients having a combined FAI. Although a chondrolabral rupture could have been expected in this series due to the presence of cam impingement, we believe this junction was found undamaged probably due to the not quite excessive mean alpha angle reported (54°).

Several arthroscopic techniques have been described to manage with pincer-type FAI. In cases of degenerative, cystic or extensively calcified labral injury, it is appropriate to debride the labrum and resect the rim with a burr in any order [6]. Nonetheless, labral preservation is preferred whenever possible [28]. Hip arthroscopic surgeons have traditionally performed a labral takedown to ease themselves

Table II. Comparative clinical outcome of patients with Tönnis 0 and Tönnis 1 pre-operative osteoarthritis

Variable	Tönnis 0	Tönnis 1	P-value
Number of patients	N = 24	N = 15	N/A
Mean pre-operative mHHS	50.56	51.22	P = 0.71
Mean post-operative mHHS	89.9	77.93	P = 0.03
Mean pre-operative Womac	32.25	26.74	P = 0.13
Mean post-operative Womac	8.31	19.03	P = 0.05
Mean post-operative pain VAS	1.5	6.3	P = 0.03
Mean post-operative satisfaction VAS	8.2	6.3	P = 0.01

Data are shown as average or as absolute number (percentage) for each Tönnis group. Two-tailed Mann-Whitney *U* test was performed to compare the groups. A *P* < 0.05 was considered statistically significant.

N, number; VAS, visual analogue scale.

Table III. Comparative clinical outcome of patients younger or older than 35 years old

Variable	Age ≥ 35 years old	Age < 35 years old	P-value
Number of patients	N = 15	N = 24	N/A
Mean pre-operative mHHS	48.33	52.48	P = 0.02
Mean post-operative mHHS	86.26	84.31	P = 0.68
Mean pre-operative Womac	32.25	26.74	P = 0.23
Mean post-operative Womac	11.08	14.15	P = 0.53
Mean post-operative pain VAS	2.2	2.3	P = 0.93
Mean post-operative satisfaction VAS	7.46	7.51	P = 0.87

Data are shown as average or as absolute number (percentage) for each Tönnis group. Two-tailed Mann-Whitney *U* test was performed to compare the groups. A *P* < 0.05 was considered statistically significant.

N, number; VAS, visual analogue scale.

in accessing to the bony rim; subsequently executing a labral refixation. However, if the chondrolabral union remains intact with a 'viewable' overhanging rim, a burr can be utilized to resect the bone excess without detaching the labrum. This procedure has been described priorly [6, 7, 9] in cases of focal pincer-type FAI, but only three series have reported its outcome; none of them in the long-term [11–13]. The purpose of this study was to describe a new series of patients with a minimum 2-year follow-up treated with this technique to aid in understanding its survival as a hip preservation method, which remains unclear.

When executing acetabuloplasty during hip arthroscopy, it seems valuable to maintain the labrum's integrity. The hip's inherent stability relies on three structures: osseous

anatomy of femoroacetabular articulation, the acetabular labrum and the surrounding capsule reinforced by ligaments. Whether one of these factors is damaged, the others will eventually fail after an initial attempt to compensate for [1]. The labrum presents numerous characteristics that might be considered essential: stability, load distribution, regulation of the synovial fluid, proprioception and maintenance of intra-articular negative pressure [10, 29]. When the labrum is resected, the intra-articular pressure gradient becomes altered due to fluid escape out of the joint, hence intensifying the contact pressures between the articular surfaces of the ball and socket [10, 30].

A previous prospective analysis with 10-year follow-up [31] has shown good clinical outcomes in a series of

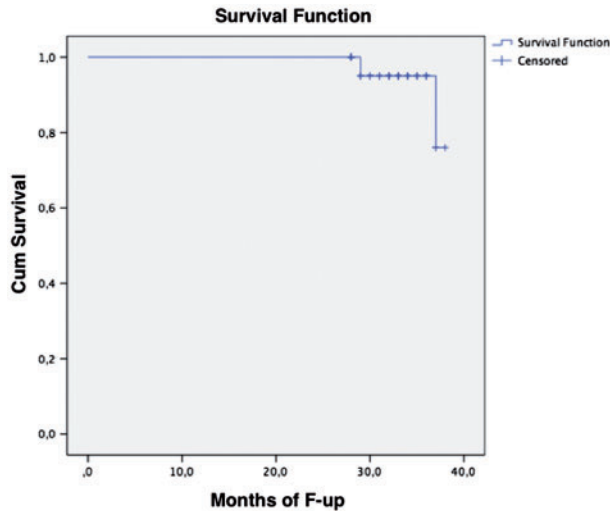


Fig. 3. Graph of the Kaplan–Meier method showing the articular survival of the series in terms of last follow-up and articular failures that required a revision surgery.

patients with labral tears and without osteoarthritis who underwent only labral debridement without osteoplasty. Nevertheless, when analysing the success of hip arthroscopy in preventing a second surgical procedure, several studies have proved the efficacy of labral refixation over labral debridement; although not examining pincer-type’s labral pathology specifically [32–35]. Krych *et al.* [12] have prospectively studied a group of female athletes with diagnosis of pincer-type and combined FAI, treating 18 of them with rim resection without divulging the labrum’s insertion and another 18 with acetabuloplasty and labral debridement, with a minimum follow-up of 12 months. Even though both groups utterly improved the Patient-Reported Outcome (PRO) score, the labral refixation group showed a significantly better hip outcome score (HOS) for activities of daily living and pain VAS than the debridement group. Conversely, our series presented a majority of male population ($n = 36/44$) mainly with combined FAI and only four women with isolated pincer-type impingement. Although our small figures made it impossible to analyse our outcome in terms of sex, we believe that including men and having a longer follow-up could make our results more generalizable.

Redmond *et al.* [13] performed a prospective case–controlled study whose aim was to compare the outcome of patients with pincer and combined FAI undergoing arthroscopic acetabuloplasty and labral refixation without labral detachment with those treated with acetabuloplasty taking down the labrum. The authors found similar outcomes between both groups, suggesting that preservation of the chondrolabral junction should be done whenever

possible, as anatomy is preserved. However, they included more patients with higher percentages of alpha angle and anterior center-edge angle in the control group, which may have been correlated with more severe CAM-type FAI and subsequent chondrolabral damage in that group. Seemingly, Ilizaliturri *et al.* [11] reported a series of 50 prospectively followed patients treated with rim reduction without chondrolabral separation, describing only one revision due to surgical adhesences. In 23 cases they only used only one lateral anchor while in the remaining 27 two anchors were used (one lateral and one anterior). Although not detaching the labrum does not avoid labral refixation, overall labral instability is eluded, as chondrolabral junction remains unharmed. Additionally, a small number of anchors are necessary to fix the labrum when compared with conventional treatment in which 2–6 anchors are usually needed [26]. In fact, we have used a mean of 2 anchors (min 1, max 3).

Although all patients in our series improved the clinical scores post-operatively; there was a statistically significant difference between patients with minimal osteoarthritis changes (Tönnis 1) and those without degenerative changes (Tönnis 0). A systematic review of the literature [36] studied the factors related to surgical failures of patients with FAI and revealed that advanced age at surgical time, presence of pre-operative radiological osteoarthritic changes and prolonged symptomatic period of time were associated with poor outcome and conversion to THA. Likewise, another study done at our institution [24] has systematically analysed the literature on the utility of arthroscopy for the treatment of hip osteoarthritis, finding out that there are currently no categorical indications for hip arthroscopy in this scenario; and concluding that as joint space narrows, worst outcomes are expected. Nonetheless, both systematic reviews included many retrospective studies with a low level of evidence; which did not categorize their outcome in terms of any of the radiological classifications of osteoarthritis. We consider that unpredictable results might be expected from a pre-operative radiograph with minimal changes in patients in plan of a hip arthroscopy. Patients with osteoarthritic degeneration should be advised of potential articular failures in the short and medium terms.

We have found no differences of outcome between patients older or younger than 35 years old. Philippon *et al.* [23] showed that patients over 50 years that underwent a hip arthroscopy exhibited a 20% conversion rate to Total Hip Arthroplasty (THA), being earlier the indication in those with a joint space of 2 mm or less. On the contrary, patients with a joint space wider than 2 mm significantly improved the mHHS, Short Form 12 and HOS scores at 3-year follow-up. This means that age did not constitute an

independent risk factor for articular failure, but only if related with a severe joint space narrowing; as reported by the former systematic review [24]. However, a retrospective study on hip preservation following hip arthroscopy at 5-year follow-up evidenced that age older than 45 at the time of surgery was an independent risk factor for THA [37].

Good clinical and radiological outcomes have been extensively reported in patients with FAI undergoing arthroscopy, even more encouraging than in patients undergoing surgical dislocation [26, 28]. The studies that compared labral resection with labral refixation have pointed significantly better radiological outcomes with fewer indications for THA when the labrum was preserved and fixed [26, 27, 33]. Redmond *et al.* [13] found no differences in revision surgeries in patients treated with acetabuloplasty with and without labral detachment. To our knowledge, no previous reports have shown the short, medium or long-term survival of patients undergoing acetabuloplasty and labral preservation. In the present series, 3 of the 44 patients (6.8%) were reoperated at an average of 32 months follow-up, which is similar to the values of Redmond *et al.* [13].

Our study had several limitations. First, its retrospective nature correlated with the biases exclusive to the design. Despite studying a consecutive series of individuals, we had not a control group of patients treated without labral detachment and therefore our clinical results could lack statistical power. Seemingly, we have assessed our clinical outcome with only two scores (mHHS and Womac). A more detailed statistical analysis of other described scores such as PRO, HOS and Non-arthritis Hip Score could have augmented the impact of our results. Secondly, we consider that the mean follow-up of the series is brief; thus our assessment of articular survival over time could be of low estimate. Thirdly, a small cohort of patients was included in each of the subgroups destined to statistical analysis. We believe our differences of outcome between Tönnis 0 and Tönnis 1 patients should be considered as best-case estimates. However, this is one of the largest series of patients treated with rim resection without taking down the labrum and aids in illustrating the results of the treatment, which still remain controversial.

In conclusion, arthroscopic acetabuloplasty without labral detachment obtained good clinical outcomes in terms of functional scores, pain and satisfaction. Minimal degenerative changes on plain radiographs correlated with worse outcomes. Studies with higher level of evidence are needed to confirm our results and validate the indication

of this procedure in patients with slight osteoarthritic changes.

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CONFLICT OF INTEREST STATEMENT

Each author certifies that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest and patent/licensing arrangements) that might pose a conflict of interests in connection with the submitted paper.

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